HYDATID DISEASE IN HUMAN POPULATION OF KASHMIR VALLEY

Regional Distribution

The present study was undertaken to evaluate the annual surgical incidence of hydatid disease in human population of Kashmir valley from January 2002 to December 2002. The total surgical admissions in all the hospitals of Kashmir valley during that period was about 30,215. Among 30,215 cases, 160 patients were surgically treated for hydatid disease. The annual surgical incidence of hydatid disease comes to about 0.59% and the incidence per 100,000 population comes to about 529.5. These figures when compared to other parts of world (listed in Table 6.1) showed that Kashmir Valley is one of the most hyperendemic region for hydatid disease. The high prevalence of hydatid disease may be attributed to 75% rural population of Kashmir whose main occupation is sheep breeding. Due to their poor socio-economic status, there remains a close association between man, sheep and dog.

The slaughtering of live stock without veterinary control, the wide spread rural practice of feeding dogs with offal of home butchered sheep and lack of public health education are probably the other reasons for higher prevalence of hydatid-disease in Kashmir valley. Besides in rural
areas, majority of the people consume water from rivers, ponds and streams etc. on the banks of which stray dogs defeacate. This may also be the reason for higher prevalence of the disease, because the Turkana (worlds highest prevalent region for hydatid disease) have been shown to become infected from drinking egg-contaminated open water (Morris and Richards, 1992). Present study thus indicates that there is an urgent need for initiation of control programme like health education, control of stray dogs, concentration of slaughtered houses etc. otherwise the infection can result in epidemics.

Table 6.1 Annual surgical incidence of hydatid disease in other parts of world.

<table>
<thead>
<tr>
<th>Country</th>
<th>Annual Figures (per 100,000 pop.)</th>
<th>Year</th>
<th>Authors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tunisia</td>
<td>1300</td>
<td>1984</td>
<td>Mlika et al.</td>
</tr>
<tr>
<td>Turkana</td>
<td>7700</td>
<td>1984</td>
<td>French and Ingera</td>
</tr>
<tr>
<td>Chile</td>
<td>9.1</td>
<td>1994</td>
<td>Ernest et al.</td>
</tr>
<tr>
<td>Germany</td>
<td>0.5</td>
<td>1995</td>
<td>Nothdurtt et al.</td>
</tr>
<tr>
<td>Argentina</td>
<td>6.8</td>
<td>1999</td>
<td>Lamberti et al.</td>
</tr>
<tr>
<td>Bulgaria</td>
<td>6.5</td>
<td>1999</td>
<td>Todorov &amp; Boeva</td>
</tr>
<tr>
<td>Chile (South)</td>
<td>161.7</td>
<td>2000</td>
<td>Apt et al.</td>
</tr>
<tr>
<td>Iraq (west)</td>
<td>2</td>
<td>2000</td>
<td>Saeed et al.</td>
</tr>
<tr>
<td>Palestine</td>
<td>3.1</td>
<td>2002</td>
<td>Abu-Hasan et al.</td>
</tr>
<tr>
<td>Libya</td>
<td>4.2</td>
<td>2002</td>
<td>Fashani et al.</td>
</tr>
</tbody>
</table>
Open slaughtering of animals

Dead animals in open fields

Unprotected slaughter houses

Close contact of definitive and intermediate hosts

Butcher giving raw offal to dog

Photographs: - Showing the factors responsible for higher prevalence of hydatid disease in Kashmir valley
Sex distribution

Out of the 160 patients in the present study there were 92 (57.5%) females and 68 (42.5%) males showing thereby preponderance of disease in females than males. Similar observations have been made by Develoux et al. (1991), Canda and Canda (1992), Dik et al. (1992). There are some observers whose figures are not in agreement with our results. Yakin Kaya et al. (1999) showed higher prevalence in males (63.33%) than females (36.67). Al-Bassam et al. (1999) showed equal proportion of males (47.6%) and females (52.3%). There seems to be no reason for the hydatid disease to have more affection for one sex. The frequency of involvement of male and female patients will vary from place to place depending upon the hygienic status of the population and the local habits of the people. Therefore it is only the living conditions of people which determines the male or female preponderance. There can be no other reason for this phenomenon.

Age distribution

In the present study majority of the patients 50 (31.5%) were seen in 3rd decade of life i.e. between 21-30 years. Below 21 years age group, the cysts were found more frequently in the lungs as compared in liver and above 31 years age group, most cysts were hepatic and relatively few were in lungs. This shows that pulmonary cyst manifest at an early age as compared to hepatic cysts which present at a later stage. The age distribution is in accordance with Amr et al. (1994), Ernest et al. (1994), Cohen et al. (1998) and Saghier et al. (2001).

The type of tissue is an important factor for the growth of the cyst. Since the hepatic cysts are slow growing, the majority of them are asymptomatic and give rise to symptoms till they are six to eight inches in
diameter (to produce discomfort and a palpable lump), a size which at the ordinary rate of growth can be reached only in twenty to thirty years. At the same time slow growth of the cyst gives the liver sufficient time for compensatory hypertrophy, so that there is no liver dysfunction and there is no deviation from normal in the general health of the patient. These facts can explain why hepatic hydatids are reflected at later stage even if the infection is acquired in the childhood.

The lungs being soft and vascular, show a fast and regular growth of hydatid cysts. Therefore, pulmonary hydatid cysts manifest at an early age because of the rapid development of cysts, producing symptoms which force the patient to seek medical advice at an early age.

**Occupational distribution**

In the present study, majority of the patients were housewives 70 (43.75%) followed by students 50 (31.25%) and sweepers 20 (12.50%). Among house-wives, majority have hydatid cysts in liver whereas in students the cysts were present in lungs. Similar findings were also reported in the studies made by Amr et al. (1994), Ernest et al. (1994), Karimove et al. (1998) and Saeed et al. (2000). According to Karimove, the higher incidence in house-wives and students is due to their constant contact with domestic animals and dogs respectively. However in the present study there was no contact between housewives with domestic animals. The high incidence of disease in house-wives may be attributed to their feeding habits. The questionnaire data of the house-wives showed that they eat unwashed vegetables while preparing them for cooking. In addition, geophagia was another reason which probably lead to high level of infection in housewives.
The higher incidence in students may be due to their physically active outdoor life leading to accidental exposure to eggs because aerogenic route of invasion is especially pronounced in students (Karimov et al., 1998).

**Socio-economic status and Hydatid Disease**

The results of previous studies have shown that hydatid infections in children are acquired as a result of handling dogs whose coats are contaminated with dried proglottids containing eggs, whereas adults are more usually infected by ingesting vegetables that have become contaminated by dog feaces. (Andrews and Lancaster, 1990; Chai et al., 1990 and Chi, 1995). As the ownership of dogs or occupational contact with dogs is an obvious risk factor for hydatid disease, since they are the definitive host of *Echinococcus granulosus*. It was surprising to find that the ownership of dogs was not associated with hydatid disease in the present study. In fact none of the respondents owned dogs because Kashmir valley is a Muslim dominated state and in Hadith (saying of Prophet SAW), the following are among several recorded statements about the undesirability of close contact with dogs:

"If a dog drinks from your vessel, you must wash the vessel seven times". "Angels do not enter a house where there is a dog". Therefore direct transmission from dogs is probably not a major source of human infection in Kashmir valley. Therefore, stray dogs may thus contribute to human infection through indirect means of exposure.

In the present study the use of domestic water from rivers, streams and ponds was found to be the important contributory risk factor for human infection. Since there is plenty of surface water in Kashmir which is consumed by majority of people in rural areas. In rural areas there is no
dearth of stray dogs many of which presumably defecate on the banks of surface waters. Rain could then wash the eggs from the faeces into the water supply. Viable taeniid eggs have been found in river sediments in Spain (Schwartzbrod et al., 1989). Even small numbers of Echinococcus eggs in the water supply have the potential to infect human population over a wide area.

In the present study, other potential sources of indirect transmission were also investigated. Majority of patients 60.62% especially women showed unhygienic feeding habits. They ate vegetable and fruits usually unwashed while preparing them for cooking. In addition, geophagia among children and pregnant women is well known. It is this which may probably leads to the high level of infection seen among children and women.

In Kashmir Valley, RCC houses and fenced houses are associated with higher socio-economic status and increased wealth. Poor living conditions are generally synonymous with poor standards of sanitation, especially in rural areas. In the present study, 65.62% of patients were living in unfenced houses with unfenced vegetable gardens where stray dogs have easy access. Therefore there is a significant association between economic status and hydatid disease.

In Kashmir Valley, it is not surprising that only 6.25% of all the cases had heard of hydatid disease, but it is of great concern that so few of the cases understood its mode of transmission.

In general, the distribution of E.granulosus is influenced by a variety of factors: agriculture, education levels, social and cultural habits.

**Distribution of Hydatid cyst by site**

It is generally recognized that the commonest site affected by hydatid cyst is the liver (63% - 75% of cases), followed by lung (15%-
25%), and only 10%-15% of cases are located in other organs (Dik et al., 1992; Molan, 1993; Stoyano et al., 1999; Magambo et al., 1998; Haridy et al., 2000 and Abu-Hassan et al., 2002). These figures are in agreement with our series (liver 65.62% and lungs 25.00%). Hydatid cysts have been recorded in practically every tissue of the body. Transport of the embryo by means of circulation appears to explain all the facts concerning distribution. After ingestion of ova, the hexacanth embryo bores its way into the portal circulation and is carried to the liver which is the first filter or 'hepatic filter'. Some of the embryos manage to escape the liver and reach the lungs, the second filter 'pulmonary filter'. From the lungs the embryo reaches the left heart via pulmonary veins and can be distributed to any organs in the body, the final filter or 'peripheral filter'. There is no reason to believe that in peripheral filter one organ or tissue will be more affected than the rest. The incidence of involvement falls as one goes from the hepatic filter to the peripheral filter because only few embryos are left to reach the peripheral circulation.

However, in the present studies in children, the lung appeared to be more frequently involved than the liver. Similar observations have been recorded by Develoux et al. (1991) and Mountinari et al. (1992).

The exact factors that determine the organ localization of the hydatid cysts remain to be elucidated but they probably include the anatomical and physiological characteristics of the host (Thompson, 1995). The small size of the hexacanth embryo from which the cyst develops in relation to the mean diameter of the vessels in the capillary beds of the liver and lung, would favour development in these beds (Lunardi et al., 1991). Evidence that the parasite can complete a lymphatic or venous migration was provided by Heath (1971). He also postulated that the size of the parasite in relation to the hosts venules and
lacteals, which differ in size with the species of host, may determine the
distribution of cysts between liver and lung in each species. In humans,
the relative size of the intestinal venules and lacteals may differ with the
age of the host. and this may account for lung hydatids being most
common in children and young adults (Zahawi et al., 1999).

In a number of published case series, hepatic cysts have been
approximately of equal in frequency in both lobes, while some surgeons
have reported a preponderance of cysts in the right lobe. In the present
study also the right lobe of liver was involved in 64.70% of cases, as
compared to the left lobe which was affected in 23.52% of cases, showing
the higher incidence of right lobe. It is generally supposed that owing to its
relatively straighter course and larger lumen, the right hepatic vein receives
a disproportionate number of embryos accounting for the greater
preponderance of right sided cysts. It is also possible that the big mass of
right lobe of liver may explain the increased preponderance of right lobe
affection as compared to the left.

In the present study, the right lung was involved in 65.30% of
cases. left lung in 30.61% and bilateral 4.06% of cases, showing
thereby the preponderance of right side involvement. Besides the right
base was more affected than the upper lobe. Similar observations have
been made by Boistsov et al. (1992) and Solak (1994). The right lung,
because of its large circulation. is more frequently affected than the left
lung. The lower lobe of the lungs were more commonly affected than
the upper lobes. it is because the ova being heavier fall to the bases,
and the right base because of the straighter course of the right bronchus.
Signs and symptoms in hepatic hydatidosis

The manifestation of hepatic hydatidosis in our studies were in order of frequency: abdominal discomfort/pain (90.47%), abdominal mass (85.71%), hepatomegaly (31.42%), urticaria, loss of appetite, jaundice and fever, chills and rigors.

Little (1988), Yadav et al. (1989), Al-Bassam et al. (1999) and Ammari and Omari (2002) reported pain as a presenting symptoms in 60%, 61.5% (38%) and 75% of patients respectively. Thus it is evident that upper abdominal pain is an important and one of the most common presenting features of hepatic hydatidosis. The higher incidence of pain as a presenting feature in our studies may be due to late manifestation of cases when the cyst had already attained larger dimensions.

Abdominal mass associated with hepatomegaly was another presenting symptom with hepatic hydatidosis. Yadav et al. (1989) and Al-Bassan et al. (1999) also reported similar findings in their series.

Some of the patients also had recurrent attacks of urticaria which gave a clue to the diagnosis.

Signs and symptoms in pulmonary hydatidosis

Most of the cases of pulmonary hydatids presented with non-specific respiratory symptoms of recurrent nature which necessitated a thorough investigation of these cases. Many of the medical works stress that if a patient gets a) repeated respiratory infection and b) persistence of symptoms after respiratory infective episode i.e. delay in the resolution of pneumonia, one should think of pulmonary tuberculosis and new growths, but we should also take into consideration the possibility of hydatid disease and investigate the patients in these lines. Hydatid disease in such cases cannot be ruled which would need further investigation.
In the present study, the uncomplicated cysts were characterized by latency. Patients with huge cysts enjoyed apparently good health. The patients with complicated cysts presented grave symptoms and signs. Most of the cases with complicated cysts presented with recurrent attacks of cough (67.5%), haemoptysis (47.5%) and chest pain (37.5%). Franquest et al. (1990), Loose and Kirch (1990), Solak et al. (1994), Ivanov (1996) and Beg and Mansoor (2002) also reported similar observations in their series. Thus, it is evident that recurrent attacks of cough, haemoptysis and chest pain are important presenting features of pulmonary hydatidosis. In the present study, only 15% of cases did not have any complaint when first seen and were picked up on routine clinical examination. The percentage of asymptomatic cases given by Boistsov et al. (1992) and Caremani et al. (1993) are 80% and 60% respectively. These figures are not in accordance with our figures, it is because most of the cases in their study were uncomplicated as compared to our study in which most of the cases were complicated, due to ignorance of the patients and late diagnosis of the disease in such cases.

**Casoni’s intradermal test and hydatid disease**

In the present series 160 surgically confirmed patients of hydatid disease were subjected to Casoni’s intradermal test and it was found to be positive in 112 (70.00%) cases. The percentage of positive results given by other observers are Amir Jahed (1975), 77%, Amin Gora (1975) 75%, Ribeiro (1975) 47.5%, Me.thuselvan (1977) 60% and Fomda et al. (2002) 60.14%. It is quite evident from above that some of our results are in conformity with results of some earlier workers. The reason for this discrepancy between the results of various observers seemed to depend on the nature of antigenic fluid used for the test. The positive results will be
more if a fresh hydatid fluid is used as against the old fluids which may give negative results.

Most of the symptomatology of the hydatid disease including intradermal sensitivity depend upon the escape of strongly antigenic fluid into the circulation through a microscopic leak in the cyst wall. This means that there should be a microscopic leak in the cyst wall to initiate the symptoms of the disease including the Casoni’s intradermal test. Therefore it can be assumed that in cysts which are quite intact, the test will be negative. Similarly when the cyst dies due to infection or calcification, the test will be negative although a cyst is still present in the body. Besides, the antigenic fluid used in test is hydatid cyst fluid which is a mixture of antigens derived from host and parasite, and some of these parasite antigens will be shared by other parasite infections leading to false positive results in man.

**Radiology**

**Plain radiographs in abdominal hydatidosis**

In a number of published works, the radiological features of abdominal hydatidosis are described as (a) organomegaly (hepatomegaly, spleenomegaly and nephromegaly) (b) soft tissue shadows in the abdomen (c) calcification (d) displacement and distortion of diaphragm. These features are seen in uncomplicated cysts. Those cysts which are complicated give radiological features of nemohydocyst and camolate sign. In the present study, the commonest finding was raised dome of diaphragm on right side in 64.7% cases, followed by circumscribed hepatomegaly in 27.7% cases. Only 7.5% of cases showed calcification suggestive of hydatid disease. Similar findings have been made by Amin-Gora (1975). Amir et al. (1975) have found that diagnostic value of radiology in abdominal hydatidosis is 9.23%. Therefore radiology is not of much help in
abdominal hydatid disease, especially uncomplicated hydatid cysts. Calcification gives a clue to the diagnosis but it does not help in making out the nature of the cyst, viability of the cyst, sight of the cyst and the number of the cyst present, because cysts which are not calcified will not be shown by Skiagrams.

**Chest-radiography in pulmonary hydatidosis**

In the present study most of the uncomplicated hydatid cyst presented smooth shadows (0.61%) and complicated cysts gave the picture of camolate sign (61.22%). These radiological signs confirmed the presence of the pulmonary cysts in 91.83%. Amir *et al.* (1975) have found that the diagnostic value of radiology in pulmonary hydatidosis is 91.49%. Anand in 1989 discussed the diagnosis of pulmonary hydatidosis in man and found 75 cases with the help of chest radiography and all these cases were confirmed at surgery. It is evident from the above discussion that radiography is more helpful in diagnosis of pulmonary hydatidosis.

**Ultrasonography in hepatic hydatidosis**

Morris and Richards (1992) reported that ultrasonography is most useful technique for hepatic hydatid. It clearly differentiates cystic from non-cystic hepatic lesions and the characteristic appearance of daughter cyst within the main cyst cavity may almost allow a definite diagnosis to be made. The appearance of multiple daughter cysts within the main cyst cavity can look like the radiating spokes of a wheel i.e. cartwheel sign. If daughter cysts or other debris are not present this does not exclude hydatid. a solitary featureless cyst can still be a hydatid cyst. In the present series 119 patients of hepatic hydatids were subjected to ultrasonographic examination, which gave a correct diagnosis in 110 (92.43%) cases. The commonest ultrasonographic appearance was multiple cysts in 35.29% of
cases, followed single simple cyst in 27.7% of cases. Similar observations
have been reported by Askarnova et al. (1991). Ultrasonography is most
useful in measuring the size and exact position of the cyst and because of
its relatively low cost and portability, has been used widely for screening,
clinical diagnosis, and monitoring of treatment of liver hydatid cysts (Frider
et al., 2001). By manipulating the patient’s body position it is sometime
possible to demonstrate floating ‘hydatid sand’ a highly specific diagnostic
sign.

**Computerized tomography (CT) in pulmonary hydatidosis**

In the present study, computerized tomography was undertaken in 40
patient of pulmonary hydatidosis and the diagnosis was established in all
the cases. 50 cysts were delineated on CT in forty cases. Compared to
conventional radiography, an additional 10 cysts were delineated on CT,
stressing the improved diagnostic value of the technique. CT localized
hydatid cysts accurately, no matter how deep seated they are in lungs as has
been reported by Keravancioglu et al. (1999). It also differentiates mother
and daughter cysts easily. CT is highly sensitive, diagnostic cost effective
and important guide for the operating surgeons, because it is not as operator
dependent as ultrasound and the hard copy gives the surgeon an accurate
road map of the sites of the cysts. (Morris and Richards, 1992). All
radiologic signs are better demonstrated by CT, and it makes visualization
of ruptured, complicated cysts better than routine radiography (Kokturk et
al. 1999).

**EFFECTS OF ANTHELMINTICS ON HYDATID CYSTS**

In the present study, the combined medication of albendazole plus
praziquantal caused severe damage to protoscolices and germinal layer of
pulmonary hydatid cysts as compared to those who received albendazole
alone. Similar results have been reported by a number of workers. For example, Taylor *et al.* (1988) studied the effects of combined albendazole and praziquantel in *in vitro* culture of protoscolices of *Echinococcus granulosus*. All combination groups were more effective than albendazole alone. Cobo *et al.* (1998) compared the effects of a combined medication of albendazole (10mg/kg/day) plus praziquantel (25mg/kg/day) to those of albendazole at different doses (10 and 20mg/kg/day). In all cases the drugs were given during the month prior to surgery. A significant increase of patients with non-viable protoscolices was observed in the group treated with the scolicides combination compared to those treated by albendazole alone. Makek *et al.* (1999) presented the results of treatment of 212 patients with either mebendazole, albendazole or praziquantel. He observed that combined chemotherapy of albendazole and praziquantel for 28 days cycle is sufficient, with surgical operation performed five days after chemotherapy. Moreno *et al.* (2001) demonstrated an efficacy of 100% when the combination of praziquantel and albendazole were used as chemoprophylactic treatment because no viable hydatid cysts developed after mice had been injected with protoscolices.

The above observations are encouraging, showing that the combined albendazole and praziquantel have good effects on hydatid cysts and therefore should be offered to patients before surgical treatment is considered, as the risk of implantation of spilled protoscolices is a real one. If protoscolices, known to be viable, are spilled during surgery (despite the usual precautions) up to 10% recurrence rate is achieved even by careful experienced surgeons. There is no doubt that surgery for recurrence is associated with higher morbidity and mortality than first operation (Morris and Richards, 1992).
HISTOPATHOLOGY OF INFECTED LUNG AND LIVER

The histological section of lungs surrounding hydatid cysts showed fibrosis with infiltration of polymorphs and mono-nuclear cells. Singh et al. (1991) also reported that lungs at places revealed area of abscess formation with neutrophilic infiltration. In the present study, the bronchi and bronchioles were dilated with degenerative changes like reduction in alveolar and bronchiolar luminal spaces. The blood vessels were distorted, alveolar septa thickened and there were accumulation of exudate in bronchioles. These morphological changes might cause severe mismatching between ventilation and pulmonary blood flow, resulting in abnormal gas exchange. Majority of the patients with pulmonary hydatids were studied on these lines by performing the tests of ventilatory capacity. There vital lung capacities were reduced, with low residual volumes and large percentage of air exhaled in the first second. Alnoor, 1997 showed patients with pulmonary cysts have decreased breath sounds especially on that side where the cysts were present.

Many works reported moderate tissue changes in the various organs of sheep and goat (Singh and Kuppuswamy, 1969; Pandey, 1971; Singh et al. 1988). They reported degenerative changes around cysts with fibrocellular reaction consisting of macrophages. In the present study also there were moderate changes in liver with deformed hepatocytes due to reduced cytoplasmic contents and large gaps were seen round the fibrous cyst wall. In the surrounding areas of liver hydatids heavily leucocytic infiltration and fibrosis was seen at various distances from the cyst wall. Anwar et al. in 1999, reported histopathological changes of hepatocytes surrounding the cyst and noted that the damage was inversely proportional to the distance from the cyst. In the present study, the hepatic architecture was completely destroyed due to pressure atrophy of larger cysts.
PREVALENCE OF HYDATID DISEASE IN LIVE STOCK

In the present study, 25.4% sheep, 27.5% goats and 39.25% of cattle were found to be infected with hydatid cysts. The present study revealed that there is a significant difference in the prevalence of hydatid disease in Kashmir valley when compared to other parts of country and world.

Table 6.2 Comparative table showing percentage of hydatidosis in live stock in other parts of world.

<table>
<thead>
<tr>
<th>Authors</th>
<th>Year</th>
<th>Location</th>
<th>Percentage of infection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chi et al.</td>
<td>1990</td>
<td>Hutubi (China)</td>
<td>Sheep: 86.6, Goat: 56, Cattle: 94</td>
</tr>
<tr>
<td>Verma and Ahlwalia</td>
<td>1990</td>
<td>U.P. (India)</td>
<td>Sheep: 2.74, Goat: 2.65, Cattle: -</td>
</tr>
<tr>
<td>Varma and Malviya</td>
<td>1992</td>
<td>Bareilly (India)</td>
<td>Sheep: 2.98, Goat: 2.44, Cattle: -</td>
</tr>
<tr>
<td>Nahmais et al.</td>
<td>1993</td>
<td>Israel</td>
<td>Sheep: 10.00, Goat: -, Cattle: -</td>
</tr>
<tr>
<td>Himonas et al.</td>
<td>1994</td>
<td>Thessalanoki (Greece)</td>
<td>Sheep: 100.00, Goat: 15.40, Cattle: 56.60</td>
</tr>
<tr>
<td>Elaussy &amp; Howad</td>
<td>1997</td>
<td>Kassala (Sudan)</td>
<td>Sheep: 30.5, Goat: -, Cattle: -</td>
</tr>
<tr>
<td>Hosseini</td>
<td>1997</td>
<td>Iran</td>
<td>Sheep: 7.10, Goat: 3.10, Cattle: 7.50</td>
</tr>
<tr>
<td>Moro et al.</td>
<td>1997</td>
<td>Peruvian Andes</td>
<td>Sheep: 87.00, Goat: -, Cattle: -</td>
</tr>
<tr>
<td>Das and Sreekrishna</td>
<td>1998</td>
<td>Pondichery (India)</td>
<td>Sheep: 37.84, Goat: 47.64, Cattle: -</td>
</tr>
<tr>
<td>Deka and Gaur</td>
<td>1998</td>
<td>U.P. (India)</td>
<td>Sheep: 2.56, Goat: 1.45, Cattle: -</td>
</tr>
<tr>
<td>Ibrahim and Craig</td>
<td>1998</td>
<td>Libya</td>
<td>Sheep: 15.8, Goat: 3.8, Cattle: -</td>
</tr>
<tr>
<td>Jarjess et al.</td>
<td>1998</td>
<td>Iraq</td>
<td>Sheep: 6.16, Goat: 8.93, Cattle: -</td>
</tr>
<tr>
<td>Sobeih et al.</td>
<td>1998</td>
<td>Al-Gassim (S.Arabia)</td>
<td>Sheep: 2.5, Goat: 3.65, Cattle: -</td>
</tr>
<tr>
<td>Utpal &amp; Das</td>
<td>1998</td>
<td>Calcutta (India)</td>
<td>Sheep: 9.1, Goat: 5.0, Cattle: 45</td>
</tr>
<tr>
<td>El-Metanawy</td>
<td>1999</td>
<td>Saudi Arabia</td>
<td>Sheep: 14.90, Goat: 24.5, Cattle: 3.1</td>
</tr>
<tr>
<td>Stoyano et al.</td>
<td>1999</td>
<td>Bourgas</td>
<td>Sheep: 55.00, Goat: -, Cattle: 42.00</td>
</tr>
<tr>
<td>Tonciera &amp; Zhelyaskov</td>
<td>1999</td>
<td>Bulgaria</td>
<td>Sheep: 50.00, Goat: -, Cattle: 29.00</td>
</tr>
<tr>
<td>Battchararaya et al.</td>
<td>2000</td>
<td>West-Bengal (India)</td>
<td>Sheep: -, Goat: -, Cattle: 33.00</td>
</tr>
<tr>
<td>Sarma et al.</td>
<td>2000</td>
<td>Guwahati (India)</td>
<td>Sheep: -, Goat: 1.79, Cattle: 13.73</td>
</tr>
<tr>
<td>Saeed et al.</td>
<td>2000</td>
<td>Arbil (Iraq)</td>
<td>Sheep: 10.90, Goat: 15.00, Cattle: 6.20</td>
</tr>
<tr>
<td>Dalimi et al.</td>
<td>2002</td>
<td>Iran</td>
<td>Sheep: 11.00, Goat: 6.3, Cattle: 16.4</td>
</tr>
<tr>
<td>Njoroge et al.</td>
<td>2002</td>
<td>Kakurus</td>
<td>Sheep: 3.6, Goat: 4.5, Cattle: 19.4</td>
</tr>
</tbody>
</table>
It is evident from the figures of Table 6.2 that some figures are very low as compared to our results and on the other hand, some are very high. These findings support the view that infection rates may vary from place to place depending on various epidemiological factors. According to Chatterjee (1980), hydatid disease is commonly found in those countries where sheep and cattle raising constitute an important industry. It is also more a disease in temperate climates than in tropical areas. In Kashmir valley, all the necessary conditions for the spread of hydatid disease are present, i.e., the climatic conditions are temperate. 75 percent of the population belongs to rural areas and moreover, majority of the people in rural areas depend partly on sheep and cattle breeding. Due to their poor socio-economic status, their remains a close association between animals and dogs. Besides, the Gujjar and Bakarwal communities, whose main occupation is livestock farming, their animals are guarded and worked by dogs. This combined with closer grazing behavior of animals constituted an important factor for the high prevalence of hydatid disease in livestock in Kashmir valley.

In the present study, cattle were more infected than sheep and goat: it is because cattle are generally slaughtered in older age groups as compared to sheep and goats which are slaughtered at an early age between 1 to 3 years. In sheep and goats also older animals were more often infected than young animals. Prevalence increased from 9.5% in lambs aged ≤ 1 to 40.40% in ewes aged ≥ 5 years. Similar observation has been reported by Lehmar et al. 1999. The prevalence of infection appears to increase with age in all animal species, reflecting no doubt an extended period of exposure to contaminated environments.

The organ-wise distribution of hydatid cysts showed that in sheep and goats, the liver was found to be more frequently involved (55.33%) and
41.81%) than lungs (20.38% and 38.18%), respectively. While in cattle, lungs (56.6%) showed comparatively higher infectivity than liver (28.3%). Similar findings have been reported by Sobeih et al. (1998), Mosinov (1999) and Toncheva and Zhelyaskow (1999).

The proportion of animals with fertile and viable cysts is an important indicator of the significance of a species as an intermediate host since viable cysts play an active role in disease transmission. In the present study, the fertility of hydatid cysts was highest in sheep (65.3%) and least in cattle (9.09%). Similar observations have been reported by Hosseini (1997), Deka and Gaur (1998), Bhattacharya et al. (2000) and Saeed et al. (2000). The low fertility rate of hydatid cysts in cattle seems to be indicative of a relatively unfavorable host parasite relationship. Due to the high fertility rate of sheep hydatid cysts they are considered to be the best disseminators of the hydatid disease in Kashmir valley. In sheep, although viable protoscolices were found in 82.23% of fertile cysts, the mean percentage of viable protoscolices was highest in 2-3 year old animals and decreased slightly with increasing age. This suggested that sheep aged ≥ 2 years are effective transmitters of infection and should be targeted in hydatidosis control programme.

The animals most frequently slaughtered for human consumption in Kashmir valley are sheep followed by goats and much more rarely cattle. Further, many more sheep are slaughtered on religious and social occasions throughout the year within private residual compounds, and the offal from these animals especially infected liver and lungs are usually offered to domestic dogs or are dumped in rubbish bins outside the houses, where stray dogs may easily feed on it. The importance of sheep in maintaining E. granulosus in Kashmir valley therefore emphasized the proper disposal of condemned offal from sheep if the infection is to be reduced.
ECONOMIC EFFECTS OF CYSTIC HYDATIDOSIS IN KASHMIR VALLEY.

The world Health Organisation has recommended that the economic impact of zoonotic disease be evaluated prior to any major intervention aimed at its control. (WHO. 1979). One aim of the present work was to quantify the financial losses resulting from hydatidosis in Kashmir Valley. Losses were divided into human health and animals health costs. In terms of the economic effects of the human infection, financial losses can be difficult to determine accurately. Whilst the cost of treatment can be calculated with some degree of precision, the costs of other, more intangible effects of the disease are more difficult to quantify. In the present estimates of the minimum costs of the disease, these other effects have simply ignored. However, this is almost certainly too conservative, as hydatidosis results in significant health problems, and recovery from surgical treatment is unlikely to be 100%. For the maximum cost estimate, however, the death of an economically active individual was assumed to have an economic effect: lost wages from the age of diagnosis until retirement age. However, regardless of the financial value of an individual life, the mortality rate among those treated for hydatidosis in Kashmir is so low (0.62% only) that the costs of the deaths has only a marginal effect on the estimates of the overall cost of the disease.

In Kashmir Valley with low income, the potential losses are great. The health care facilities are poorly developed, and economy largely dependent on subsistence agriculture. particularly the incidence of hydatidosis is often relatively high among agricultural workers. Torgerson et al. (2002), in his study in Uruguay stated that in a fully developed upper income country, the estimates of true income losses caused by disability might have to be revised downwards as the standard of medical
intervention should be high and any resulting physical deficits in physical functioning less severe. Upper income countries are also likely to have a mechanized, less labour intensive economy in which any physical deficits will have less effect.

Hydatidosis is zoonotic disease with significant effects on livestock in addition to causing human morbidity. Infection in livestock is widespread throughout the world, often with a considerable proportion of sheep, in particular, being infected. For example, the prevalence of infection in sheep has been observed approximately 26% in Kashmir (Hidayat et al., 2001), 16% in Uruguay (Torgerson et al., 1998) and ≥ 50% in some other parts of the world (Lahmar et al., 1999). With such high prevalence, even modest effects of the parasite on the performance of an individual animals translate into considerable losses to the agricultural economy. The lungs, livers and occasionally other organs of infected livestock are often severely infiltrated with cysts, and there is considerable evidence to show that the economic effects of the disease in livestock are great.

The economic effects of hydatidosis have recently been explored in Uruguay (Torgerson et al., 2000), Wales U.K. (Torgerson and Dowling, 2001), and Jordan (Torgerson et al., 2001). These three differ considerably: Uruguay is a developing country of upper middle income with an annual gross domestic product (GDP) of US $ 5166 per capita, whereas Wales, as a part of the United Kingdom, is a wealthy, industrialized nation, with an estimated annual GDP of US $ 18130 per capita and Jordan, a developing country with an annual GDP estimated at US $ 1182 per capita. Some countries among the worlds poorest have a GDP considerably lower than that of Jordan. Kashmir (India) for example is a part of developing country with an annual GDP estimated at only US $
276 per capita (Statistical Digest 2001). Torgerson et al. (2000) estimated that total annual costs in Uruguay as ranging between US $ 2.9 million and US $ 22.1 million per year. In Wales U.K. hydatidosis in each year probably costing the U.K. economy more than US $ one million and perhaps as much as US $ 7.9 million per year. (Torgerson and Dowling, 2001). In Jordan annual economic losses attributable to hydatidosis ranges from US $ 2.6 million to 6.53 million (Torgerson et al., 2001). While in Kashmir the annual economic losses attributable to hydatidosis ranging from US $ 0.27 million to as much as US $ 2.48 million. Although the prevalence of hydatidosis in livestock and incidence of human cases are both markedly higher in Kashmir valley than in above three parts of world, the individual cost items are less expensive in Kashmir because of the less developed economy than others. For example, the surgical treatment of a human case of hydatidosis in Kashmir valley is cheaper than the treatment of a Welsh case or Uruguay case. (Kashmir US $ 257. v/s Welsh US $ 6721. v/s Uruguay > US $ 10000).

In conclusion, putting a financial value of the disease effects of a zoonosis such as hydatidosis, should help in formulating policy to determine the best use of limited resources. The economic evaluation presented here will provide valuable information for cost benefit analysis to determine if eradication of Echinococcus granulosus from Kashmir will be of economic benefit. Successful control of hydatidosis will produce economic benefits in the agricultural industry, in addition to improving human health.

PREVALENCE OF ECHINOCOCCOSIS IN STRAY DOGS

In the present study, 44.68% of dogs have been found infected with Echinococcus granulosus, with 60% of infection in rural dogs and 17.64% in urban ones. The present study showed that rural dogs are more infected
with Echinococcus granulosus. This perhaps is not surprising, since both the prevalence in animals and surgical incidence in humans are high in rural population of Kashmir valley. The percentage of infection given by other observers in some parts of the world are tabulated below.

<table>
<thead>
<tr>
<th>Authors</th>
<th>Year</th>
<th>Location</th>
<th>Percentage of infection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chi et al.</td>
<td>1990</td>
<td>China</td>
<td>16.2</td>
</tr>
<tr>
<td>Verma and Ahlwalia</td>
<td>1990</td>
<td>U.P. (India)</td>
<td>21.24</td>
</tr>
<tr>
<td>Varma and Malviya</td>
<td>1992</td>
<td>Bareilly (India)</td>
<td>36.8</td>
</tr>
<tr>
<td>Molan</td>
<td>1993</td>
<td>Israel</td>
<td>56.0</td>
</tr>
<tr>
<td>Nahmais et al.</td>
<td>1993</td>
<td>Israel</td>
<td>3</td>
</tr>
<tr>
<td>Lamberti et al.</td>
<td>1999</td>
<td>Argentina</td>
<td>2.6</td>
</tr>
<tr>
<td>More et al.</td>
<td>1999</td>
<td>Pruvian Andes</td>
<td>46</td>
</tr>
<tr>
<td>Maleky &amp; Muraskhan</td>
<td>2000</td>
<td>Iran</td>
<td>48</td>
</tr>
<tr>
<td>Larne et al.</td>
<td>2000</td>
<td>(Patazonia) Argentina</td>
<td>2.3</td>
</tr>
<tr>
<td>Lahmar et al.</td>
<td>2001</td>
<td>Tunisia</td>
<td>21</td>
</tr>
<tr>
<td>Dalimi et al.</td>
<td>2002</td>
<td>Iran</td>
<td>19.1</td>
</tr>
</tbody>
</table>

It is evident from above figures that the infection rates vary from place to place and depend on several epidemiological factors. The contributing factors for high infection rate in the rural dogs of Kashmir valley are: - The large number of stray dogs; uncontrolled slaughtering of animals and unsupervised disposal of infected offal; slaughter of animals in places other than abattoirs; the poor disposal of dead animals. The low socio-economic status of major chunk of the population as well as the lack of knowledge regarding the life cycle of parasite combined with temperate climate are suitable for most of the year for the survival and disposal of the parasite.
IMPACT OF HEALTH EDUCATION PROGRAMMES IN HYDATID CONTROL.

Almost all successful programmes rely on health education to initiate and sustain interest in control. Now that the socio-cultural factors have been identified, the efforts can be made to impart education for the control of the disease through educational or electronic media. In the present work it was intended to evaluate the impact of health education programmes in control of hydatid disease. The people were given awareness about the disease, its causative organisms, mode of transmission etc. through media, seminars, pamphlets, etc. The emphasis was laid on the need to prevent dogs gaining access to raw offal, stray dog control, restrictions or control of home slaughter of sheep and safe feeding of dogs. In August 2001, the prevalence of infection in stray dogs surveyed was 17.6% in urban areas and 60% in rural areas. After the completion of 2 years of educational campaign (from August 2001 to July 2003), the prevalence decreased significantly in urban areas from 17.6% in 2001 to 5.3% in 2003 and in the rural areas from 60% in 2001 to 52.3% in 2003.

There have been several programmes in which the educational component has contributed much in the control. A historic and often coated example is that of Iceland, where in 1864 Crabbe produced booklet in the Iceland language. This was regarded as being unusually successful because of the natural literary disposition of Icelanders (Beared, 1973). However, often it has been found elsewhere that pamphlets and other visual programmes have had measurable effect. In both New Zealand and Tasmania, the special educational features were of the community involvement. Emphasis was also placed on the need to prevent dogs gaining access to raw offal and encouraging the building of effective on farm offal disposal. In Tasmania (McConnell and Greon, 1979) a mobile testing
laboratory was used and the owners of infected dogs were immediately informed of the results in front of their neighbors. In the case of Cyprus (Polydorou, 1980), the infected dogs were destroyed. This combined with educational approach was also rapidly followed and the results which showed reduction in the prevalence of hydatidosis in the sheep. Lloyd et al. (1998) studied the effects of an educational programme on transmission of *Echinococcus granulosus* from dogs to sheep in Wales, U.K. There the education programme was backed by anthelmintic control which showed significant results.

It must be noted that the positive achievements of successful control programmes, however, significant at local levels, have not markedly changed the global distribution and public health importance of hydatid disease. In most endemic areas especially in J&K state of India, effective control has not been even attempted and much remains to be done. The above valuable experiences in the educational aspects of control represented both developed and developing countries. They do not, however, take account of the problems of education faced by countries like India where subsistence farming still applies and primary health care is in its infancy. It is the intention of the veterinary public Health unit of the world Health organization through its zoonoses centers to ensure that experiences in health education such as those described above can be readily available to all countries contemplating control of echinococcosis.